Acoustic Bat Surveying at Oyster Creek in Lacey, Ocean Township, Ocean County

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1. Objectives

The following acoustic survey was completed to provide a summary of bat species, including any federally listed Threatened and Endangered (T&E) bat species present within the proposed Ocean Wind 1 project area. This acoustic survey serves as a follow up to the Bat habitat assessment conducted as part of the Ocean Wind 1 Construction and Operations Plan (COP) development along the Onshore Export Cable Route located in Ocean County, NJ.

2. Introduction

Bat acoustic surveying was conducted at three New Jersey locations in accordance with the 2022 United States Fish and Wildlife Service (USFWS) Range-wide Indiana Bat & Northern long-eared Bat Survey Guidelines (King et al. 2022). These surveys utilized Pettersson D500x full-spectrum bat detectors with external cabled directional microphones. All recorded Wav files were evaluated by John Chenger at Bat Conservation and Management to obtain Maximum Likelihood Estimates (MLEs) using USFWS-approved automated acoustic bat identification software programs (Kaleidoscope Pro, Bats of North America 4.2.0/A:-1 and SonoBat3 NE).

3. Materials and Methods

Acoustic surveys were initiated in July and concluded by August 15 in order to meet the summer survey season window in accordance with USFWS guidelines (King et al. 2022). Surveys were conducted at three New Jersey locations using three Petterson D 500X detectors. The proposed Oyster Creek cable route (CR) was surveyed using linear guidelines (King et al. 2022). Two days prior to the beginning of the survey window, all three detectors were deployed approximately 12m (40ft) from a known *Eptesicus fuscus* (Big brown bat) roosting site. Full-spectrum recordings were uploaded to SonoBat and reviewed to confirmed the presence of bat calls. Upon deployment, a "snap test" was used to confirm secure microphone connections and detector sensitivity.

Acoustic detectors were placed in the most suitable habitat sites within the project locations, including forest edges, water edges, small clearings, and forested corridors. For each acoustic survey site, the dates, start and end times, site coordinates, microphone direction, and weather data were recorded. Detector were programed to run from dusk until dawn based on the uploaded GPS coordinates at each site (Appendices, A and C). Once triggered, recordings would last for five seconds with no downtime scheduled in between recordings (Appendix B). Representative photographs of each acoustic survey site were taken (Appendix D). A brief description of each site where a detector was deployed was recorded and can be found in Table 1. The directional microphones were attached to the top of extendable painter's poles with rubber bands and zip ties. On average, the microphones were elevated approximately three meters (12ft) to minimize ground interference. Microphones were not inhibited by any weatherproofing, however, a PVC capsule was used to protect the connection point between the microphone and microphone cable. In habitat areas with high insect clutter or canopied corridors, microphones were deployed with a directional cone to improve recording quality. For more information on microphone deployments, see Appendix C. Detectors were housed in weatherproof boxes and placed at the base of the painter's poles. Signs stating the purpose of the equipment ("scientific monitoring")

and contact information were put on the boxes. If weather conditions, such as persistent rain (more than 30 minutes), strong sustained winds (greater than an average of 14.5kph [nine miles per hour] for more than 30 minutes), or cold temperatures (below 10°C [50°F] for more than 30 minutes), occurred during the first five hours of a survey night, that location was surveyed for additional nights as needed.

Table 1. Brief descriptions of the sites where the detectors were deployed for all events at the proposed Oyster Creek cable route (CR). Descriptions include nearby vegetation, substrate, human-made structures, roads, power lines, etc.

Location	Event	Site	Site Descriptions
CR	1	1	Many short coniferous trees with a few, sporadic, taller coniferous trees. Sandy/grassy corridor (dirt road) with prickly pear cactuses. A lot of ground mosses. SW of quarry (~0.15km, 0.09mi). N of small stream connected to Oyster Creek (~0.04km, 0.02mi). Slightly S of paved road (~0.06km, 0.04mi). Microphone pointing W.
		3	On edge of thick, shrubby forest with medium-height, coniferous and deciduous trees. Blueberry bushes and ferns. Pointed down a grassy, sandy, gravel road right next to marsh. S of large housing development (~0.12km, 0.07mi). Slightly W of marsh pond (~0.02km, 0.01mi). W of Barnegat Bay (~0.52km, 0.32mi). N of Oyster Creek (~0.40km, 0.25mi). Microphone pointing SE.
	2	2	A clearing (relative to surrounding area) with tall, sporadic, deciduous trees and minimal ground cover. Right next to dirt road. N of Oyster Creek (~0.45km, 0.23mi). S of large housing development (~0.18km, 0.11mi). SE of Vincent Clune Park (~0.25km, 0.16mi). W of marsh (~0.73km, 0.45mi). Microphone pointing SE down dirt road.

3 Proposed Oyster Creek Cable Route (CR)

The CR location is in Waretown, Ocean Township, Ocean County, New Jersey. Of the three survey locations, the CR location was the only one that required linear surveying. This location had three detectors positioned approximately 0.80km (0.50mi) apart. Detectors were placed in the most suitable habitat available in a way to maximize coverage of the proposed tree-clearing route (Figure 2, Appendix C). Surveying took place for six consecutive nights at Sites 1 and 3 during the first event and five consecutive nights at Site 2 during the second event. The first event began on July 26 at 20:36 and ended on August 1 at 5:31, surveying the nights of July 26, 27, 28, 29, 30, and 31. Data collected on the night of July 31 were not used due to poor weather conditions. The second event began on August 3 at 20:31 and ended on August 8 at 5:41, surveying the nights of August 3, 4, 5, 6, and 7. Therefore, this location had a total of 15 detector nights. During the first five nights of the first event, the weather was cloudy, dry, and slightly breezy. The weather was clear, dry, and windy on all nights of event 2. For more information on weather, see Appendix A.

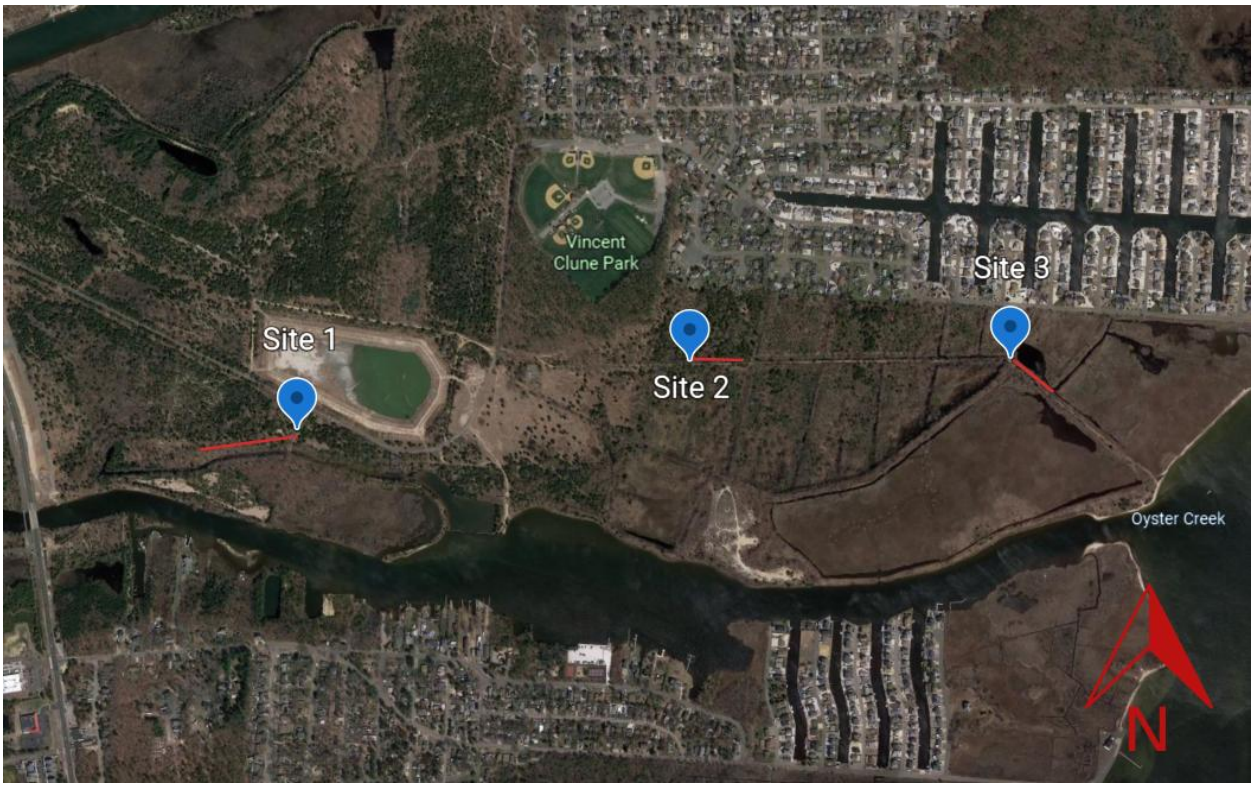


Figure 1. Google Earth map depicting bat detector sites and microphone directions at the proposed Oyster Creek cable route (CR) location in Ocean County, New Jersey on the nights of July 26 to 31 and August 3 to 7, 2022.

4. Analysis

Acoustic data was first filtered and classified using Kaleidoscope Pro, Bats of North America 4.2.0/A:-1 (Table 2). Species presence was also cross-validated using SonoBat 3 with the Northeast regional classifier (Table 3). During the qualitative full-spectrum analysis, a subset of files of each species from each site was manually reviewed to confirm presence. Additionally, all calls automatically classified by either software program as a species in the *Myotis* genus was manually reviewed. During the manual review, calls lacking sufficient detail to be confidently identified at the species level were classified as either "HF-UID," indicating the presence of a species that makes high frequency calls, "LF-UID," indicating the presence of a species that makes low frequency calls, or "2bat," indicating the presence of two individual bats simultaneously. A change in call patterns when an individual bat encounters another, make these "2bat" calls difficult to identify to a species level. The manual review also determined that the majority of mis-classified files were calls from the repertoire of the *Lasiurus borealis* (Eastern red bat). These most often are some phase of an Eastern red bat approach, but sometimes were simple search calls as well. There were no "search phase" calls with descending tails, as would be required for *myotis* search calls. Additionally, those call sequences often showed varied characteristic frequencies as would be expected from an Eastern red bat rather than any myotis species.

5. Results

Over the course of the survey, which took place on various nights between July 13 and August 15, 1,788 total bat calls were recorded. A quantitative analysis of the recorded data revealed a MLE of < 0.05 for the presence of *Eptesicus fuscus* (Big brown bat), *Lasiurus borealis* (Eastern red bat), and *Myotis lucifugus* (Little brown bat; Table 4). Upon manual review of 367 call files, it was determined that there were no *Myotis* species present in the dataset (Table 5).

Table 2. Summary of bat calls recorded from July 13 to August 15, 2022 on all survey nights at the proposed Oyster Creek cable route (CR), as classified by Kaleidoscope Pro, Bats of North America 4.2.0/A:-1.

Common Name				Big brown bat	Eastern red bat	Hoary bat	Silver-haired bat	Eastern small-footed bat	Little brown bat	Northern long-eared bat	Indiana bat	Evening bat	Tricolored bat
Scientific Name				Eptesicus fuscus	Lasiurus borealis	Lasiurus cinereus	Lasionycteris noctivagans	Myotis leibii	Myotis lucifugus	Myotis septentrionalis	Myotis sodalis	Nycticeius humeralis	Perimyotis subflavus
Location	Event	Site	Date										
CR	1	1	26-Jul	32	16	1	10	0	1	0	1	1	2
			27-Jul	29	5	6	10	0	0	0	0	2	0
			28-Jul	19	1	0	4	0	2	0	0	0	0
			29-Jul	13	7	3	5	0	1	0	0	2	0
			30-Jul	7	4	2	2	0	2	0	0	0	0
		3	26-Jul	3	0	3	10	0	0	0	0	1	0
			27-Jul	31	0	5	59	0	1	0	0	0	0
			28-Jul	33	2	2	15	0	0	0	0	1	0
			29-Jul	17	1	3	24	0	3	0	0	0	0
			30-Jul	7	1	0	1	0	1	0	0	1	0
	2	2	3-Aug	44	68	2	6	0	35	0	2	31	3
			4-Aug	221	44	10	18	1	27	0	2	17	6
			5-Aug	62	44	1	5	0	35	0	1	18	0
			6-Aug	194	73	5	8	0	110	1	5	23	4
			7-Aug	47	76	0	2	0	95	0	3	23	1
Total				759	342	43	179	1	313	1	14	120	16

Table 3. Summary of bat calls recorded from July 13 to August 15, 2022 on all survey nights at all detector sites at the proposed Oyster Creek cable route (CR), as classified by SonoBat 3 with the Northeast regional classifier.

*These calls were made by species with high frequency calls, but lack sufficient detail to be identified at the species level.

Common Name				HF-UID*	Big brown bat	Eastern red bat	Hoary bat	Silver-haired bat	Little brown bat	Indiana bat	Evening bat	Tricolored bat	Total
Scientific Name					Eptesicus fuscus	Lasiurus borealis	Lasiurus cinereus	Lasionycteris noctivagans	Myotis lucifugus	Myotis sodalis	Nycticeius humeralis	Perimyotis subflavus	
Location	Event	Site	Date										
CR	1	1	26-Jul	0	35	13	0	5	0	0	1	0	54
			27-Jul	0	37	4	0	3	0	0	0	0	44
			28-Jul	0	18	2	0	1	0	0	0	0	21
			29-Jul	0	15	5	2	0	0	0	0	0	22
			30-Jul	0	8	3	1	0	0	0	0	0	12
		3	26-Jul	0	5	0	1	3	0	0	0	0	9
			27-Jul	0	21	1	0	24	0	0	0	0	46
			28-Jul	0	30	1	2	2	0	0	0	0	35
			29-Jul	0	14	1	1	9	0	0	0	0	25
			30-Jul	0	6	1	0	1	0	0	0	0	8
	2	2	3-Aug	1	41	81	3	4	0	0	0	0	130
			4-Aug	0	209	49	1	5	1	1	1	2	269
			5-Aug	0	60	69	1	0	1	0	0	0	131
			6-Aug	2	172	67	1	1	1	1	2	0	247
			7-Aug	5	44	118	1	0	2	0	0	0	170

Table 4. Summary of Maximum Likelihood Estimates (MLEs) calculated by Kaleidoscope Pro, Bats of North America 4.2.0/A:-1, from July 13 to August 15, 2022 on all survey nights at all detector sites at the proposed Oyster Creek cable route (CR).

Note: Maximum Likelihood Estimates (MLE's) interpretation – values <0.05 indicate there is 95% confidence that the species is present. **Bold** values indicate significance.

Common Name				Big brown bat	Eastern red bat	Hoary bat	Silver-haired bat	Eastern small-footed bat	Little brown bat	Northern long-eared bat	Indiana bat	Evening bat	Tricolored bat
Scientific Name				Eptesicus fuscus	Lasiurus borealis	Lasiurus cinereus	Lasionycteris noctivagans	Myotis leibii	Myotis lucifugus	Myotis septentrionalis	Myotis sodalis	Nycticeius humeralis	Perimyotis subflavus
Location	Event	Site	Date										
CR	1	1	26-Jul	**0.00**	**0.00**	1.00	0.75	1.00	1.00	1.00	0.55	1.00	1.00
			27-Jul	**0.00**	**1.18E-03**	0.21	0.77	1.00	1.00	1.00	1.00	1.00	1.00
			28-Jul	**0.00**	0.42	1.00	1.00	1.00	0.08	1.00	1.00	1.00	1.00
			29-Jul	**1.00E-07**	**2.06E-05**	0.39	0.80	1.00	1.00	1.00	1.00	1.00	1.00
			30-Jul	**1.02E-04**	**1.89E-03**	0.40	1.00	1.00	0.37	1.00	1.00	1.00	1.00
		3	26-Jul	0.69	1.00	0.12	**3.07E-04**	1.00	1.00	1.00	1.00	0.39	1.00
			27-Jul	**2.60E-06**	1.00	0.99	**0.00**	1.00	0.12	1.00	1.00	1.00	1.00
			28-Jul	**0.00**	0.08	1.00	0.14	1.00	1.00	1.00	1.00	1.00	1.00
			29-Jul	**5.95E-05**	0.55	0.90	**4.00E-07**	1.00	**0.01**	1.00	1.00	1.00	1.00
			30-Jul	**1.79E-05**	0.42	1.00	1.00	1.00	0.58	1.00	1.00	0.95	1.00
	2	2	3-Aug	**0.00**	**0.00**	1.00	1.00	1.00	**5.50E-06**	1.00	1.00	1.00	1.00
			4-Aug	**0.00**	**0.00**	1.00	1.00	1.00	**1.00E-05**	1.00	1.00	1.00	1.00
			5-Aug	**0.00**	**0.00**	1.00	1.00	1.00	**0.00**	1.00	1.00	1.00	1.00
			6-Aug	**0.00**	**0.00**	1.00	1.00	1.00	**0.00**	1.00	1.00	1.00	1.00
			7-Aug	**0.00**	**0.00**	1.00	1.00	1.00	**0.00**	1.00	1.00	1.00	1.00
Overall				**0.00**	**0.00**	1.00	1.00	1.00	**0.00**	1.00	1.00	1.00	1.00

Table 5. Summary of bat calls recorded from July 13 to August 15, 2022 on all survey nights at all detector sites for the proposed Oyster Creek cable route (CR), as manually classified by John Chenger at Bat Conservation and Management.

Common Name				2bat	HF-UID	LF-UID	Noise	Big brown bat	Eastern red bat	Hoary bat	Evening bat	Tricolored bat	Total
Scientific Name								Eptesicus fuscus	Lasiurus borealis	Lasiurus cinereus	Nycticeius humeralis	Perimyotis subflavus	
Location	Event	Site	Date										
CR	1	1	26-Jul	1	1	0	0	0	3	0	0	0	5
			27-Jul	0	0	0	0	0	0	0	0	0	0
			28-Jul	0	0	0	0	0	2	0	0	0	2
			29-Jul	0	0	0	0	0	1	1	0	0	2
			30-Jul	0	0	0	0	0	2	1	0	0	3
		3	26-Jul	0	0	0	0	0	0	1	0	0	1
			27-Jul	0	0	0	0	0	1	0	0	0	1
			28-Jul	1	0	0	0	0	0	0	0	0	1
			29-Jul	0	0	0	0	0	3	0	0	0	3
			30-Jul	0	0	0	0	0	1	0	0	0	1
	2	2	3-Aug	2	6	0	0	3	33	1	0	0	45
			4-Aug	8	4	0	0	0	27	0	0	2	41
			5-Aug	2	0	0	0	0	34	0	0	0	36
			6-Aug	6	17	1	0	0	101	0	0	0	125
			7-Aug	2	7	0	0	0	92	0	0	0	101
Total				22	35	1	0	3	300	4	0	2	367

[1]The manual review determined two or more individual bats were present simultaneously. Bat call patterns change when an individual bat encounters another, making them difficult to identify to a species level.

[2]The manual review determined that these calls were made by species with high frequency calls, but lack sufficient detail to be identified at the species level.

[3] The manual review determined that these calls were made by species with low frequency calls, but lack sufficient detail to be identified at the species level.

[4]Kaleidoscope Pro, Bats of North America 4.2.0/A:-1 identified these data as bat calls. Through manual review, these data were determined to be only miscellaneous noise, not actual bat calls.

APPENDIX A: WEATHER

Descriptions of the weather, including temperature, wind, rain, and average cloud cover from July 13 to August 15, 2022 for each night of each event at the proposed Oyster Creek cable route (CR).

Location	Event	Date	Temp (ºF)	Temp (ºC)	Wind (mph)*	Wind (kph)*	Rain	Avg. Cloud Cover (%)
CR	1	26-Jul	69	21	<10	<16	dry	67
		27-Jul	70	21	<10	<16	dry	58
		28-Jul	74	23	<10	<16	dry	10
		29-Jul	74	23	<10	<16	0.06in/0.15cm	58
		30-Jul	71	22	<10	<16	dry	19
	2	3-Aug	70	21	12	12	dry	0
		4-Aug	71	22	<10	<16	dry	21
		5-Aug	73	23	<10	<16	dry	6
		6-Aug	72	22	10-15	16-24	dry	0
		7-Aug	75	24	10-15	16-24	dry	3

*Ranges include gust speeds. Wind was not sustained at these speeds all night.

APPENDIX B: EQUIPMENT SETTINGS

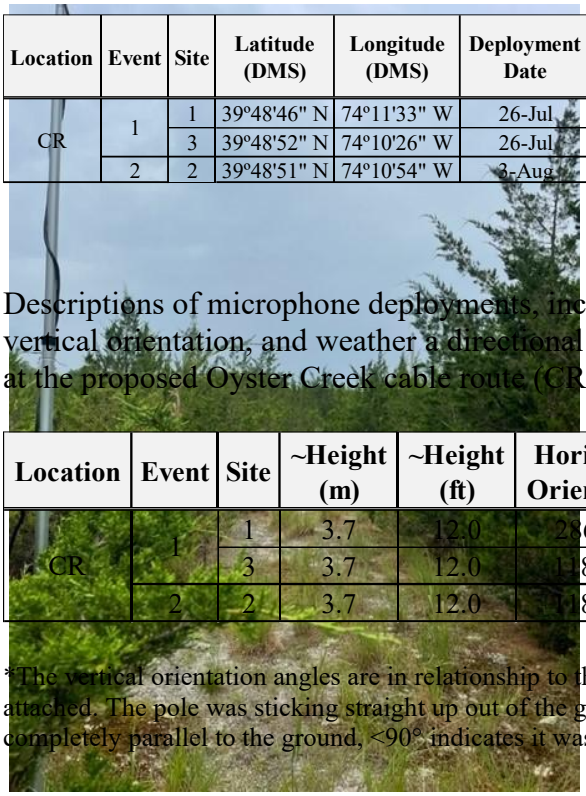
Petterson D 500X bat detector settings for each event at the proposed Oyster Creek cable route (CR).

Location	Event	Site	UTC Time Zone	Sample Freq (kHz)	Pretrig	Rec Len (sec)	HP Filter	Auto Rec	T. Sens	Input Gain	Trig Lev	Interval
CR	1	1	-04	500	OFF	5	YES	YES	MED	45	160	0
		3	-04	500	OFF	5	YES	YES	MED	45	160	0
	2	2	-04	500	OFF	5	YES	YES	MED	45	160	0

APPENDIX C: DEPLOYMENT DETAILS

Descriptions of detector deployments, including GPS coordinates, dates, and times for each event at the proposed Oyster Creek cable route (CR).

Location	Event	Site	Latitude (DMS)	Longitude (DMS)	Deployment Date	Deployment Time	Recovery Date	Recovery Time	# Nights Deployed	# Nights Used	Daily Start Time	Daily End Time
CR	1	1	39°48'46" N	74°11'33" W	26-Jul	14:09	1-Aug	10:14	6	5*	20:36	5:31
		3	39°48'52" N	74°10'26" W	26-Jul	12:31	1-Aug	9:53	6	5*	20:36	5:31
	2	2	39°48'51" N	74°10'54" W	3-Aug	8:54	8-Aug	10:15	5	5	20:31	5:41



Descriptions of microphone deployments, including height off the ground, horizontal orientation, vertical orientation, and weather a directional cone or weatherproofing was used for each event at the proposed Oyster Creek cable route (CR).

Location	Event	Site	~Height (m)	~Height (ft)	Horizontal Orientation	Vertical Orientation*	Directional Cone	Weatherproofing
CR	1	1	3.7	12.0	286° W	90°	no	no
		3	3.7	12.0	148° SE	90°	yes	no
	2	2	3.7	12.0	148° SE	90°	yes	no

*The vertical orientation angles are in relationship to the painter's pole on top of which the microphone was attached. The pole was sticking straight up out of the ground, therefore, 90° indicates the microphone was completely parallel to the ground, <90° indicates it was pointed down, and >90° indicates it was pointed up.

APPENDIX D: PHOTOGRAPHIC RECORDS

Photo 1. View of habitat corridor in the direction of microphone orientation at Site 1 at the proposed Oyster Creek cable route (CR) location.

Photo 2. View of bat detector and microphone deployment at Site 1 at the Oyster Creek cable route (CR) location.

Photo 3. View from bat detector showing microphone orientation down forested corridor at Site 2 at the Oyster Creek cable route (CR) location.

Photo 4. View of bat detector and microphone deployment at Site 3 at the Oyster Creek cable route (CR) location.

Photo 5. View of habitat in orientation with microphone deployment at Site 3 at the Oyster Creek cable route (CR) location.

Works Cited

King, Andrew, et al. *Range-Wide Indiana Bat & Northern Long-Eared Bat Survey Guidelines*. U.S. Fish and Wildlife Service, 29 Mar. 2022, https://www.fws.gov/sites/default/files/documents/USFWS_Range-wide_IBat_%26_NLEB_Survey_Guidelines_2022.03.29.pdf.